

Claims

1. An apparatus for a gaseous fuel injection system including:
 - (i) A first chamber including an inlet connectable with a source of gaseous fuel at a required inlet pressure;
 - (ii) A second chamber connectable with an engine or other apparatus so as to supply gaseous fuel thereto and further connected with said first chamber through a controllable valving means;
 - (iii) A flow control means having an inlet connectable with said first chamber and an outlet connectable with an orifice means for controlling the pressure at the outlet of said flow control means to be no more than 53% of the inlet pressure;
 - (iv) Detection means for detecting said outlet pressure and controlling said valving means;
 - (v) The arrangement being such that controlling the said flow control means to adjust the flow of gaseous fuel therethrough controls the said outlet pressure which in turn controls said controllable valving means and the pressure in said second chamber, so as to thereby control the flow of gaseous fuel to said engine or other apparatus.
2. The apparatus of Claim 1 wherein, in use, the pressure in said second chamber is maintained at less than 53% of said pressure in said first chamber.
3. The apparatus of Claim 1 or 2 wherein said fluid control means is a high speed solenoid valve.
4. The apparatus of Claim 1, 2 or 3 wherein said controllable valving means includes a valve body separating said first and second chambers and a first diaphragm having a first side in fluid communication with said first and said second chambers, said diaphragm adapted to provide a variable opening between said first side of said first diaphragm and said valve body for said gas to flow from said first chamber to said second chamber via said valve body,

wherein said opening varies in response to said outlet pressure of said flow control means.

5. The apparatus of Claim 4 wherein said first diaphragm includes a second side opposite said first side and in fluid communication with a third chamber, wherein said variable opening of said controllable valving means is varied by varying a pressure in said third chamber.
10. The apparatus of Claim 5 wherein said pressure in said third chamber is varied by varying an opening of a valve between said third chamber and said second chamber.
15. The apparatus of Claim 6 wherein said opening of said valve between said third chamber and said second chamber is controlled by a second diaphragm having a first side in fluid communication with said third chamber and a second side opposite said first side in fluid communication with a fourth chamber which is in fluid communication with gas from said outlet of said fluid control means.
20. The apparatus of Claim 6 or 7 wherein said valve between said third chamber and said second chamber includes a needle with a tapered notch.
25. The apparatus of Claim 7 or 8 including an acceleration stage diaphragm having a first side in fluid communication with said outlet of said flow control means and a second side opposite said first side in fluid communication with an intake manifold of said engine or other apparatus downstream of a throttle valve of said engine or other apparatus, wherein said acceleration stage diaphragm deflects towards said first side of said acceleration stage diaphragm when a pressure in said intake manifold increases, thereby increasing said pressure in said fourth chamber and increasing said opening of said variable valve.
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10. The apparatus of any one of the previous claims including a feedback controlled regulator stage between said inlet and said first chamber.
11. The apparatus of Claim 10 wherein said feedback controlled regulator stage includes a first second stage chamber having an second stage inlet, the first second stage chamber in fluid communication with a second second stage chamber via a second stage controllable valving means, an outlet from said second second stage chamber connectable with said first chamber, a second stage diaphragm controlling said second stage controllable valving means and in fluid communication with said second second stage chamber on a first side and a feedback chamber on an opposite second side, wherein a pressure of the gas in said feedback chamber is controlled by a feedback regulator means which varies said pressure in response to a pressure of the gas in said second stage outlet, thereby maintaining said pressure in said second stage outlet at a substantially constant pressure.
12. A method of controlling the flow of gaseous fuel in a fuel injection apparatus, said method including:
 - (i) Providing a first chamber connectable with a source of gaseous fuel at a required inlet pressure;
 - (ii) Providing a second chamber connectable with an engine or other apparatus and in gas flow connection with said first chamber through a controllable valving means;
 - (iii) Providing a flow control means having an inlet connected with said first chamber to receive gaseous fuel therefrom and an outlet connected with a first orifice means so adapted that the outlet pressure of said flow control means is no greater than 53% of the said inlet pressure;
 - (iv) Said method further including the control of said gaseous fuel flow by said flow control means, so as to control the said outlet pressure and detecting said outlet pressure and controlling said valving means in response to said outlet pressure so as to control the pressure in said second chamber and therefrom the gaseous fuel flow to said engine or other apparatus from said second chamber.

13. The method of Claim 12 including maintaining the pressure in said second chamber at less than 53% of the pressure in said first chamber.
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14. The method of Claim 12 or 13 wherein said flow control means is a high speed solenoid valve.
15. The method of Claim 12, 13 or 14 wherein said controllable valving means includes a valve body provided between said first and second chambers and a first diaphragm adapted to control the flow between said first and second chambers through said valve body by means of a variable opening between said first diaphragm and said valve body; the method including varying said variable opening of said controllable valving means by varying a pressure on an opposite side of said diaphragm to said valve body.
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16. The method of any one of Claims 12 to 15 including providing a feedback controlled regulator stage between said inlet and said first chamber.
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17. An apparatus for a gaseous fuel injection system utilising the method of any one of Claims 12 to 16.
18. A feedback controlled regulator stage including a first chamber having an inlet connectable to a source of gas at a substantially constant pressure, the first chamber in fluid communication with a second chamber via a controllable valving means, an outlet from said second chamber, a second stage diaphragm controlling said controllable valving means and in fluid communication with said second chamber on a first side and a feedback chamber on an opposite second side, wherein a pressure of a gas in said feedback chamber is controlled by a feedback regulator means which varies said pressure in response to a pressure of the gas in said outlet, thereby maintaining said pressure in said outlet at a substantially constant pressure.
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19. An apparatus for a gaseous fuel injection system substantially as herein described with reference to the accompanying figures.
- 5 20. A feedback controlled regulator stage substantially as herein described with reference to Figure 1.
21. A method of controlling the flow of gaseous fuel in a fuel injection apparatus substantially as herein described.